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The Nutritional Value of Opuntia FicusIndica Meal and the Effect of its Inclusion in the Diet of Fattening Lambs

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ABSTRACT

This study investigates the effect of incorporating cactus grain cake in the feed ration of OuledDjellal lambs on fattening performance.Twenty young rams were evenly distributed in 4 lots with 5 animals each, having received a ration based on oat hay, alfalfa hay, straw and a concentrate containing 0% meal, 15% (15% Substitution), 30% (30% Substitution) and 45% (45% Substitution) of cactus grain cake. They were reared for 98 days including a 14 day adaptation period.

According to thisanalyzes, cactus grain cake offers a non-negligible rate of crude protein (CP) 9.45%. Knowing that lignin is an undesirable element in digestion in ruminants, it transcribes the highest rate with 35.74%, it contains a large proportion of fiber, ie (40.53% of CF and 73.42% NDF). Depending on the calculation formula chosen, formula, true forage units (MFU) vary between 0.3-0.96, Nitrogenic intestinal digradable protein (NIDP) between 66.15 - 222.15 and energical intestinal degradabl protein (EIDP) 26.26 and 1023.38. The results obtained showed that the incorporation of cactus grain meal affected the zootechnical performance of lambs during the fattening period (P <0.0001). The final average weights of the lambs are 44, 20; 39.78; 41.92; and 43.86 kg respectively for the 0% Sub, 15% Sub, 30% Sub and 45% Sub lots. Average daily earnings decreased and consumption indices increased with the rate of incorporation of cactus seed cake.

As the conditions for the use of cactus grain cake by ruminants are still poorly understood, further trials are needed on ruminants as well as on monogastrics.

Keywords :- Algeria; Cactus grain; fattening; meal; sheep.

Introduction

In Algeria, sheep represent the tradition in breeding [10]. They occupy an important place in the national economy 60% of the workforce is in the steppe. The Ouled-Djellal breed is the most important numerically and the most interesting economically, it is mixed (wool and meat). But is currently experiencing many difficulties mainly due to insufficient fodder resources, the often irreversible degradation of pastoral resources and drought. This situation has pushed the country to the massive import of raw materials (barley, corn, soybean meal, CMV, etc.) at very high prices, which affects the profitability and sustainability of this breeding.

The price of feed is becoming off-putting for many breeders, both for commercial mixes and for simple feeds used for making farm mixes. So the soaring price of raw materials has led breeders to seek control over their costs. Supplementation systems based on locally available alternative food resources can be one of the solutions to reducing ruminant production costs.

In this sense, the cactus (Opuntiaficus-indica) and its by-products take on an importance more and more accelerated with the expansion of areas cultivated in it. Indeed, the HCDS (High Commission for the Development of the Steppe) carried out thousands of hectares of planting of 60,000 ha cacti [14] within the framework of the development of the steppe,wich makes cactus by-products widely available. Knowing that the production of a liter of cactus oil generates between 30 - 45 kg as waste (cactus seed cake) [1]. A cake that constitutes up to 90% of the weight of the raw material, it is very rich in cellulosic fibers. The other constituent polysaccharides are very rare, or even non-existent [16].

The objective of this work is to study the effect of the incorporation of cactus grain cake (5%, 15%, and 45%) in the ration of Oueld –Djellal breed lambs on fattening performance. . In order to promote this local by-product and replace a part of imported soybean meal.

MATERIALS AND METHODS

The test took place at the Technical Institute of Breeding of Ain M'lila in Oum-El-Bouaghi province (Algeria), during the months of January to April 2020.

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Animal material

Twenty male lambs of the OuledDjellal breed (29 ± 3 kg; 8-9 months) were distributed at random into four batches of Cinque and assigned to 4 diets. All the animals were reared in tie-stalls in a sheepfold and dewormed before the start of the trial.

Diets

The ration is based on a concentrated feed called T0% (00% cactus grain meal, 100% concentrate), T15% (15% cactus grain meal, 85% concentrate), T30% (30% cactus grain meal, 70% concentrate) and T45% (45% cactus grain meal, 55% concentrate), while the coarse feed (alfalfa hay, oat vetch hay and straw) is the same for the 4 lots (Table 1). Cactus grain cake comes from the cactus processing unit (Nopaltec) located in the commune of SidiFredj (wilaya of Souk Ahras). They were ground and given to the animals after having mixed them with the concentrate according to the aforementioned proportions.

The ration distributed at the start and at the end of the test was adjusted according to the refusal as follows:

• Lot 1 at the start of the test

(200 g of concentrate + 00 g of cactus grain cake + 200 g of alfalfa hay + 400 g of oat hay + 500 g of straw) = 1300 g per lamb.

Given the amount of rejection (>10%), the% oat hay and straw were gradually reduced, the other components are maintained (Concentrate, Cactus grain cake and alfalfa hay). Oat hay was reduced from 400g at the start of the test to 300g at the end, however, straw was reduced from 500g to 200g at the end.

Ration distributed from 02/15/2020 until the end of the experiment (04/13/2020) "approximately two months".

• Lot 1 (200 g of concentrate + 00 g of cactus grain cake + 200 g of alfalfa hay + 300 g of oat hay + 200 g of straw) = 900 g per lamb.

• Lot 2 (% coarse feed is the same as for (lot 1) only the concentrated feed is changed).

(170 g of concentrate + 30 g of cactus grain meal + 200 g of alfalfa hay + 300 g of oat hay + 200 g of straw) = 900 g per lamb.

• Likewise, the calculation is carried out for lots 3 and 4 (table 1).

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Table 1. Formulation and chemical composition of different regimen.

Feed	Lot1 T_0	Lot2 T_{15}	Lot3 T_{30}	Lot4 T_{45}
Concentrated	22	19	16	13
Cactus grain cake	00	03	06	09
alfalfahay	22	22	22	22
oathay	33	33	33	33
straw	22	22	22	22
Teneur en nutriments calculée en %				
DM%	95.27	93.55	95.09	95.27
MM	7.40	6.31	7.48	7.76
CF	24.16	23.06	25.18	25.31
CP	10.65	10.44	10.30	9.94

DM : dry matter ; MM : mineral matter ; CP : crude protein ; CF : crude fiber

All the rations of the 4 batches are iso-nitrogenous and iso-energetic as shown by the forage analysis in Table 1 Since we clearly notice that all the values of the chemical composition of the 4 diets are very close.

Experimental protocol and measured parameters

All rations are given twice / day during the 84 trial days preceded by a 14 day adaptation period.

The measurement will take place once a day. The zootechnical parameters measured are: the distributed and the refusal in the morning and the evening, the intake in the morning and in the evening and of course the initial and final live weight, as well as a weighing was taken every 7 days to determine the performances. fattening (average daily gain ADG and conversion index CI).

Food rations must be iso-energetic and iso-proteinic and for this we are obliged to use the nutritional value estimation equations (MFU PDI according to the chemical parameters that we have assayed CB, MAT, MG and MM). We had no difficulty in calculating the nutritional value of all the foods constituting our rations, on the other hand for Opuntia seed cakes, the published scientific research is very limited or even non-existent for this we used the formulas of other cakes. These are cakes of: sunflower, soybean and rapeseed. This is in order to predict the nutritional value of this food then make a comparison and choose the most suitable (Table 2).

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Table 2. Equations for estimating the nutritional value of sunflower meal, soybean meal and rapeseed meal

	MFU	NIDP	EIDP
Sunflower	1,14-0,017ADF ou 1,09-0,017CF (Chapoulot and *al*.,2009)	0,7CP (Patrick and *al*.,2009):	0,7CP (Patrick and *al*.,2009):
Soybean	1,19-0,006 CF ou 0,9+0,005CP ou 1,19-0,005ADF (Chapoulot and *al*.,2009)	0,7CP (Patrick and *al*.,2009):	0,7CP (Patrick and *al*.,2009):
rapeseed	0,0128 Fat + 0,9393 (Bendailh.,2010):	- 0,2347 Fat + 226,99 (Bendailh.,2010):	- 0,1171 Fat + 104,79 (Bendailh.,2010):

MFU : Meat Forag unit ; NIDP : Netrogenic intestinal digestible protein; EIDP : Energical intestinal digestible protein

Chemical analysis

The chemical analyzes were carried out at the animal production laboratory of the national institute for agronomic research in Algiers. The chemical composition of the cactus grain cake as well as the other components of the ration were determined according to the AFNOR method (1982) [5] with a double repetition of the sample. The analyzes focused on dry matter (DM), total nitrogenous matter (TNM), crude fiber (CF), fat (Fat), mineral matter (MM) and wall components (NDF, ADL, HC, CV and Ln). 4 Samples of each ration was analyzed. The chemical composition of the foods used in (Table 3).

Table 3. The chemical composition of the constituents of the ration distributed to the lambs

	DM (%FM)	MM (%DM)	CF (%DM)	CP (%DM)	Fat (%DM)	NDF (%DM)	ADF (%DM)	HC (%DM)	CV (%DM)	Ln (%DM)
Concentrated	94,21	4,56	3,04	15.53	1.5	21.86	8.87	9.73	4.74	1.30
Cactus grain cake	94,02	2,16	40,53	9.45	2,6	73.42	49.35	24.07	14.03	35.74
alfalfahay	92.52	11.3	17.97	18.27	2.4	44.42	21.56	22.69	15.71	6.46
oathay	93.63	6.67	29.65	3.85	1.4	6.09	34.15	25.94	20.08	14.7
straw	93.60	7.45	31.60	2.55	1.3	67.52	38.48	29.04	27.31	11.03

DM : dry matter ; MM : mineral matter ; CP : crude protein ; CF : crude fiber ; Fat : fatty matter ; NDF : Neutral detergent fiber ; ADF : acid detergent fiber ; HC : hemicellulose ; CV : coefficient of variation ; Ln : lignin

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Statistical analysis

The feedings, refusals and the weights of the sheep at the end of the experiment were the subject of simple descriptive statistical analysis: mean, standard deviation, and coefficient of variation with Statview software.

Analysis of variance (ANOVA)

By an adjustment on the model: $Y_{ij} = \mu + \alpha_i + e_{ij}$

where: Y_{ij} is the explained variable; μ : the general average; α_i: the factor effect

e_{ij} : the residual error of the model. Then, Student's test was used to compare the factors two by two.

RESULTS AND DISCUSSION

The results of the chemical composition of the cactus grain meal as well as the other components are shown in (Table 3).

The dry matter content is greater than 90% in all the foods constituting the ration of the 4 batches; this shows that the samples were well preserved after grinding and the plant has little residual water. The best rate of mineral matter is recorded by alfalfa hay with 11.03% and the lowest rate is transcribed by the control cactus grain cake 2.16% (Table 3). The latter records the highest rate of crude fiber 40.53% even in NDF (73.42%) and ADF (49.35%), followed by straw with 31.6% of CF and 67.52% (NDF), 38.47% (ADF) then alfalfa hay offers an average rate of 18% crude fiber. This same hay has the best total nitrogen rate 18.27% higher than that of the concentrate 15.53%. Cactus grain cake offers a not insignificant rate of CP 9.45% better than those of the other two feeds oat hay and straw respectively 3.85% and 2.55% of CP (Table 3). Knowing that lignin is an undesirable element in digestion in ruminants, cactus grain meal transcribed the highest rate with 35.74% followed by the two feeds oat hay and straw respectively 14.69 and 11% (Table 3).

We note that the four diets have a CF content that varies between 22% and 25%. The CP content as a percentage of DM varies between 10% and 11%. The crude fiber content fluctuates between 23-25% and the average of the four diets is 24.43%. The MM content for the four diets and the four refusals is the same 6-8% (Table 1).

The MFU and NIDP values of the concentrate are higher; on the other hand the EIDP value is lower (Table 4).

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It seems that these cakes are the richest in crude fiber (40.53%) compared to several cakes widely used as soybean, sunflower or rapeseed cake [29, 12, 23], but the lowest in protein source compared to these same cakes [29, 12, 23], since it only records (9.45 %) similar to the value given by Ranaivoarisoa et al [26].

Since research on Opuntia seed cakes is limited; to predict the nutritional value of this one we used the formulas of the other cakes. Thus notable differences were recorded according to the authors which necessitated other specific research. However, the MFUs found by the formula of soybean and rapeseed are comparable but for NIDP and EIDP the difference is notable which can be explained by the low rate of the total nitrogenous matter measured by the cakes of the seeds of 'Opuntia (Table 4).

Table 4. The nutritional value of the constituents of the ration distributed to the lambs

	MFU	NIDP	EIDP
Concentrate B07	0,98	101,18	39,41
Cactus grain cake (Sunflower cake formula)	0.3 ; 0.4	66.15	26.26
Cactus grain cake (Soybean cake formula)	0.947; 0.95; 0.94	66.15	26.26
Cactus grain cake (rapeseed cake formula)	0.965	222.15	102,38
Alfalfahay	0.68	113.75	101.4
Oat Hay	0.74	23.97	66.1
Barley straws	0,33	24	46

If we take into consideration the high content of CF (40.53%) is and especially lignin (35.74%) which can be completely indigestible, it exerts a negative effect on fattening performance in our experiment, we find that the values of Sunflower cake : MFU = 0.3 NIDP = 26.26 EIDP = 66.15, are the values most suitable for our food and reflect the fodder values of cactus seed cake.

However, the exact determination of the forage value requires other fattening tests and digestibility tests and also clarifications to know the presence or name of anti-nutritional factors, a problem recently encountered in co-products of the agro-industry [25] cited by Jorfi et al (2014) [20].

The fat content (2.06%) is comparable to that found by Ranaivoarisoa et al [26] this proportion of fat is lower compared to peanut cake (3.4%), higher than sunflower cake 35 (0 , 4%) and that of soybean meal (1.7%) according to Sauvant et al [29]. The latter is included in the composition of all the concentrates distributed to ruminants in Algeria. On the other hand, the

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rate of mineral matter is lower compared to several oil seeds [29]. This low content can be explained by the types of Opuntia production soils in Algeria. Usually poor sandy soils with little development, especially in arid and semi-arid areas.

For the three cakes, soybean, Rapeseed and Tourne sol, the nitrogen content is respectively 52%, 38% and 35% [9]. The CP content of rapeseed varies between 18% and 35%, with an average of 29.9% [9]. The more the fat content of the meal increases, the more the CP content decreases [7].

Regarding the chemical composition of alfalfa hay, the results do not differ from those published by many researchers [19, 26, 21, 18, 2 and 3], and therefore the MFU, NIDP, EIDP values are almost identical to other protein forages [15, 28, 8].

The results of the chemical composition of straw are close to those reported by several authors [31, 12, 13] except for CF (31.6%) which is really lower than the results found in the same authors (40%, 47% and 42%) respectively. On the other hand, the results of analyzes of the walls of the straw expressed as a percentage of dry matter found by Xandé et al (1978) [31] are as follows: NDF 78.5-82.4%, ADF 55.4-61.8 and Ln 8.6 -12.4% which is higher than our results except for lignin the rates are comparable 11.03% (Table 3).

Oat hay offers a fiber rate of 29.65% CF lower than the rate found by Hedir (2019) [24] 41.16%, a comparable MM rate 6.5% and 7.45% as well as the CP that we found 3.85% while the author records 1.68%.

Each batch consists of 5 sheep, at the first weighing the weight of the animals varied between 23.8 Kg and 32 Kg. The average of the 4 batches was 27.58 Kg. After the adaptation period which lasted 14 days (two weeks), the weight changed to become 29.15 Kg average of the 4 batches with a minimum of 25,4 Kg and a maximum of 34, 2 Kg (Table 5). These values are considered as the initial weight of the trial period which began on 01/20/2020 and ends on 04/13/2020, i.e. 84 days. During this period the individual effect is remarkable since some lambs register a continuous growth, others a capricious growth, in other words an increase followed by a decrease then another recovery (figures 1).

Table 5. Evolution of the body mass of lambs during the test period

	initial weight 20/01	weight 01/02	weight 08/02	weight 15/02	weight 22/02	weight 07/03	weight 14/03	weight 21/03	final weight 13/04

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batch 1	28,2	33,2	32,46	32,28	35,44	35,76	35,86	36,36	44,2
batch 2	26,32	29,6	30,3	29,54	33,08	33,12	34,26	38,36	39,78
batch 3	30,44	34	33,42	31,68	35,44	34,56	36,84	38,16	41,92
batch 4	31,62	34,8	34,6	34,3	36,24	36,6	38,16	38,76	43,86
Average	29,145	32,9	32,695	31,95	35,05	35,01	36,28	37,91	42,44

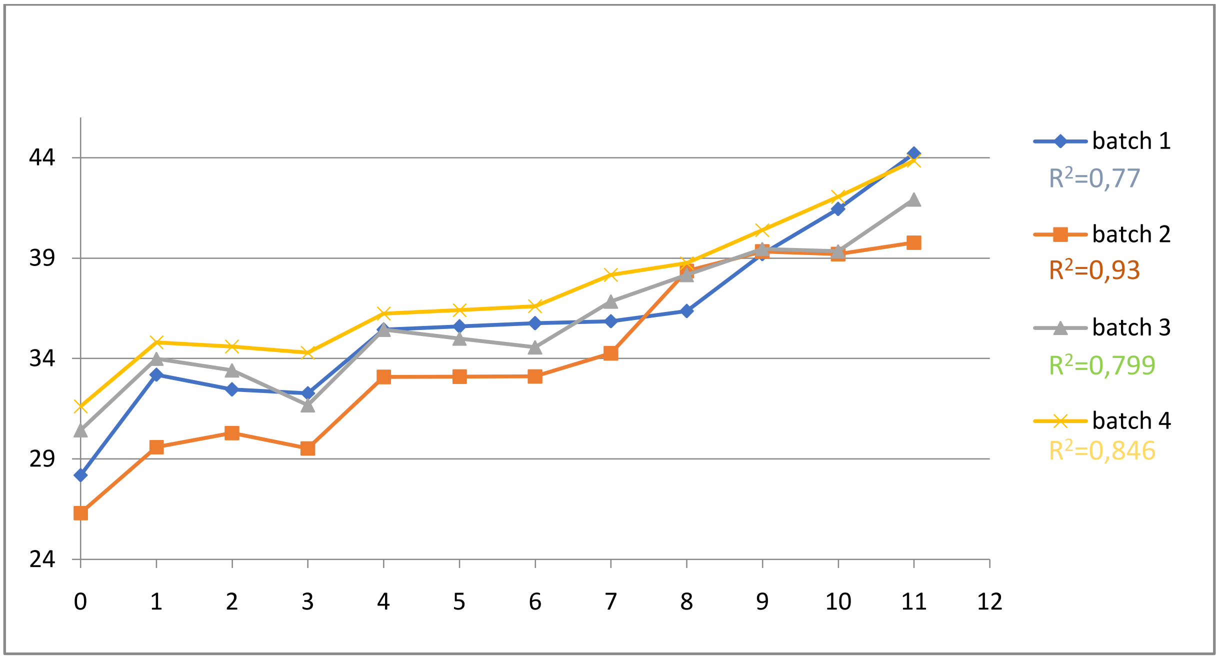

Figure .1. Average weight of animals in batch 1, 2, 3, 4

In addition, on the proportion of walls, ingestibility depends on the characteristics acting on the senses of the animal, which constitute the palatability of the forage odor, taste, roughness, etc [22]. This explains the refusal in the four batches which is characterized by a low CF content not exceeding 4.62% in batch 3 and 3.63% in batch 4. The average of the four refusals is 4.28% (Table 6). Moreover, the CF content varies between 31.51% in batch 3 and 32.60% in batch 1, the average of the four refusals is 32.21% (Table 6). This shows that Sheep exert a selective grip on the ration. The main factor that varies the digestibility of a food is its content of these wall carbohydrates. This explains according to [22], for fodder, the digestibility which decreases with the advancement of the vegetation stage, the plant being richer in fiber the older it is.

Table 6. The chemical composition of the refusal of the 4 batches and the average.

	Refused1	Refusal2	Refusal3	Refused4	Average

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DM%	93,11	92,13	93,67	93,87	93 ,19
MM	6,79	6,52	6,65	6,54	6,62
CF	32,6	32,14	31,51	32,6	32,21
CP	4,55	4,23	4,62	3,63	4,28

The voluntary consumption of ruminants is therefore selective, undergoes a double regulation, initially volumetric. It restricts the level of ingestion of rations based on fodder, the more the latter are poorer. An optimum of concentrate, allowing maximum ingestion, is reached when the nutritional requirements are met Wolter (1988) [27]. The size of the ration having ceased to be limiting, it is the biochemical regulation that intervenes to equalize the energy intake to the needs. It also derives a certain deviation from the sharing of the net energy in favor of adipogenesis because the increase in the food proportion of concentrate increases the propionate / acetate proportion in the mixture of fatty acids resulting from fermentations [27]. Between these two volumetric and biochemical thresholds the faculty of physiological adaptation thanks to the phenomenon of substitution, without any consequence other than an economic loss by waste of concentrate must be calculated [27].

Growth and fattening performance

The change in the live weight of the control batch (0% substitution) is greater than for batches 15, 30 and 45% of concentrate substitution by cactus grain cake. The live weights went from 44.20 kg for the 0% sub batch to 39.78 kg for the 15% sub batch, and from 41.92 kg for the 30% sub batch to 43.86 kg for the 45% batch sub. In general, the rations influenced the final live weights of the lambs (Table 7), conversely to the rate of incorporation of cactus seed cake into the ration. The 45% sub lot comes out of this theory a little and gives better results than its neighbor the 30% sub batch.

Table 7. The distributed, the live weight gain and the conversion index in the 4 lots of lambs.

batch number	The quantity dispensed for each lot / days (Kg)	% of DM for each batch	The quantity distributed for each batch / day (Kg de DM)	The quantity distributed for each batch during the whole fattening period (Kg de DM)	Average weight gain for each batch	Conversion index (Kg de DM / weight gain) per batch

batch 1	2,097	92,46	1,94	162,96	16	10,18
batch 2		92,46		162,96	13,46	12,10
batch 3		92,45		162,96	11,48	14,18
batch 4		92,44		162,96	12,24	13,30

The same trend was observed for the mean daily gains (ADG) which were significantly different between the lots ($P \leq 0.01$). The ADGs recorded during the fattening period are 191, 160, 137 and 148 g / d respectively for the 0% sub, 15% sub, 30% sub and 45% sub batches. Compared to the control batch, a decrease of 54 g was observed in the 30% sub diet, which recorded the lowest ADG of all batches. The significant difference in ADG between the experimental batches (ADG the average of the 4 batches = 158.3 g) and the control batch (ADG = 190 g) due to the low nutritional value of the cakes compared to the concentrate (MFUconcentrated = 0.98 and MFUcake = 0.30 and CPconcentré = 15.53% and CPcake = 9.5%). This variability between all the batches, despite the contribution of the equivalent nutritional value (MFU, NIDP, EIDP), probably due to a better or poor efficiency of the rate of incorporation of the mixture (cake and concentrate) and to a good digestive use between the different components of the ration (associative digestibility) since as we announced in the introduction the breed reacts to the slightest care.

Indeed, the total replacement of the concentrate by the meal has a direct influence on the ADG since in a test on sheep the rationed animals (les concentrate) have a lower average daily growth than the lambs receiving concentrate at will and their fattening lasted 13 days. Furthermore. They consumed 26% less concentrate but 4 times more hay, i.e. 31% more total dry matter [30; 32]. The constituents of the rations also influence since the levels of hay ingestion are on average higher than with rations based on protein crops or legumes (+ 6.1 kg). This is even more obvious when the hay distributed is of very good quality [17].

Ration performance through ingestion and refusal

The analysis of variance of the 4 regimes and 4 refusals show a very highly significant difference for the two chemical parameters CF and CP ($P < 0.0001$) and a significant difference for the MM parameter ($P < 0.5$). They show a very high negative correlation between CF and DM. The correlation is highly significant between CP and CF (appendix 1 and 2).

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The analysis of variance of the 4 diets show only a significant difference for the parameter CP (P <0.5). The correlation is highly significant positively between the mineral matter and the DM, the MM and the CF between CP it is negatively significant (appendix 3 and 4).

The analysis of variance of the 4 refusals shows only a very highly significant difference for the chemical parameter CP (P <0.0001). The only visible correlation is between MM and DM positively (**) (appendix 5 and 6).

The best average ingested per batch per day is recorded in batch 4 (45% substitution) with 2007.98g / day. The witness recorded an average ingestion of 1948.18g / day not far from the other two batches: 1908.56g / day and 1932.65g / day respectively for batch 2 and 3 (Table 9).

The quantity distributed for each batch per day is the same 2.097 kg which corresponds to 1.94 Kg of DM per day and 162.96 Kg of DM for the whole test period (Table 7). At the end of the test, the 4 batches recorded a different average gain in weight, the best being 16 kg in the control, followed by the second batch with 13.46 kg. Through the conversion index of the material dry in meat (Kg DM / Kg of P0.75) the classification of the lots is reversed since it is the lot which records the lowest weight gain which records the highest conversion index 14.18 (lot 3) while the conversion index for the 45% Sub batch is 13.30 Kg DM / Kg (table 4).

The lambs ingested in the evening are more or less better than those in the morning, with a difference of 1.82 g in batch 4 and 20.6 g in batch 2, the control (usual ration of animals) shows a difference of 9.64 g (Table 9).

To predict the quantities ingested, many authors have fitted the ingested capacity (IC) to an allometric model CI = a PVb with a straw-dominant ration a = 0.85.

The first factor in the variation in the amount ingested is the size of the animal, assessed by live weight but even better by metabolic weight. In Table 8, the IC and the amount of dry matter as a function of metabolic weight is comparable in the 4 batches; it varies between 13.5 and 14.5.

Table 8. The intake expressed in metabolic weight of lambs in the 4 batches

batch number	The average intake for each batch / day	% of DM for each batch	The average intake for each batch / day (g of DM)	average final weight per batch	p¾	The amount ingested in g of DM / p¾	IC = 0,85*P0,75
batch 1	1948,18	92,46	1801,32	44,2	17,142	105,081	14,57
batch 2	1908,56	92,46	1764,57	39,78	15,840	111,401	13,46

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batch 3	1932,65	92,45	1786,74	41,92	16,475	108,454	14,00
batch 4	2007,99	92,44	1856,27	43,86	17,043	108,916	14,49
Average	1949,34	92,45	1802,23	42,44	16,625	108,463	14,13

IC: ingestion capacity

By analogy, if the intake in the evening is better than that in the morning, the refusal in the morning is higher. Indeed, for the four batches the refusal in the morning exceeds that in the evening except for the 4th batch where the rate of substitution of concentrate is replaced by the rate of cake at 45%, the difference in the refusal of the total ration is very low 6 g. Batch 2 shows the highest refusal in the morning (Table 9). However, no refusals were recorded of this new food where we noticed that all the distributed quantity of the cactus grain cake was consumed. The final weight per lot shown in table 7 shows a tangible approach between batch1 (control) and lot4 (45% substitution of concentrate by the cake). Perhaps to obtain a better weight, it is necessary to increase the substitution rate.

Table 9. The difference between refusal and ingested in the morning and in the evening

	batch 1	batch 2	batch 3	batch 4
Morning refusal average in g	532,7	662,22	564,41	358,97
Average evening refusal in g	508,75	587,14	561,25	365,53
The difference in refusals (Morning - Evening)	23,94	75,08	3,16	-6,57
Average intake in the morning in g	969,42	944,30	983,27	1003,11
Average intake in the evening in g	979,06	964,90	969,58	1004,94
The difference from the ingested (Morning-Evening)	-9,65	-20,61	-6,31	-1,83

The analysis of the variance of the amount of refusal and ingestion shows a very highly significant difference between the 4 batches P is <0.0001 (Table 10). The highest standard deviation of the ingested is 45.34 in batch 1 and the lowest is 33.2 in batch 4. On the other hand, for the refusal the highest standard deviation is 62, 21 in batch 3 the other batches have a comparable standard deviation (Table 10).

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Table 10. Analysis of the variance of ingested and refusal of the 4 batches of sheep

The ingested and the refusal by batch	Average intake and refusal in g	Variance	degree of liberty	Standard deviation	Chi2	P	Meaning
Ingested 1	2213, 34	34953,18	16	45,34	559250,86	<0,0001	***
Ingested 2	2161,63	33435,41	16	44,35	534966,58	<0,0001	***
Ingested 3	2165,75	28807,41	16	41,17	460918,60	<0,0001	***
Ingested 4	2285,34	24806,95	16	33,20	396911,26	<0,0001	***
Refusal 1	1049,18	45425,28	16	51,69	726804,47	<0,0001	***
Refusal 2	1361,24	45437,82	16	51,70	727005,06	<0,0001	***
Refusal 3	1132,41	65782,63	16	62,21	1052522,1	<0,0001	***
Refusal 4	641,53	45271,01	16	51,60	724336,24	<0,0001	***

***: very highly significant

Table 11. Analysis of the variance of the average weights of the 4 batches at the end of the test

batch weight	Medium Per batch in Kg	variance	degree of liberty	Standard deviation	Chi2	p	Meaning
P1	44,2	7,159	19	0,598	136,03	<0,001	***
P2	39,78	8,305	19	0,644	157,8	<0,001	***
P3	41,92	6,588	19	0,574	125,170	<0,001	***
P4	43,86	7,188	19	0,599	136,570	<0,001	***

***: very highly significant

CONCLUSION

The incorporation of cactus seed meal into the lamb ration had negative effects on fattening performance and this feed appears to be of low nutritional value compared to other oil seeds widely used in animal feed. However, according to chemical analyzes, the peculiarity of its composition lies in their richness in crude fiber and its low CP content.

The analyzed data represent a first published approach to the use of cactus grain meal in animal feed.

However, if this study provided some information concerning the evaluation of the chemical composition and the effect of the incorporation of cactus grain cake on the zootechnical performance of OuledDjellal lambs, we still need to carry out other analyzes and tests to understand the effect of incorporating this by-products on the different animal species categories.

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